

DSN Research and Technology Support

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The activities of the Development Support Group, including the Microwave Test Facility, during the two-month period ending June 15, 1972, are summarized. Activities include operational clock synchronization, precision antenna gain measurements, weak source observations, pulsar observations, demonstration of SCOUR computer program for automatic antenna tracking, planetary radar experiments, dual-carrier measurements, and shipment of the tricone support structure. Activities at the Microwave Test Facility include DSN klystron testing and general machine shop and other support for the Venus Station. Significant maintenance activities include replacement of an azimuth drive gear reducer and rework of the elevation ball screw nuts on the 26-m-diameter antenna.

During the two months ending June 15, 1972, the Development Support Group was engaged in the following activities.

I. DSS 13 Activities

A. In Support of Section 331

1. **Pulsars.** The Venus Deep Space Station (DSS 13) continues to devote approximately twenty-four hours per week (a total of 205 hours during this period) to the observation of pulsars. Information obtained includes pulse-to-pulse spacing, pulse time of arrival, and pulse shape. Pulsars regularly observed (about 22 of the 50 known pulsars) were tabulated in Ref. 1.

2. **Planetary radar.** As part of the support for the MVM 73 missions, ranging of the planet Venus has been

routinely accomplished using a range resolution of 1500 meters round trip, without interpolation. Range data have been collected on five separate occasions, transmitting and receiving at DSS 14, with modulation generation, control, and data processing taking place at the Venus station. Additionally, three Venus mapping experiments, identified as "active interferometer," have been successfully accomplished. In this latter experiment, both DSS 14 and DSS 13 use a very stable frequency standard (hydrogen maser) and transmissions are made from DSS 14 with reception being simultaneously accomplished at DSS 13 and DSS 14. As before, modulation generation, control, and data processing take place at DSS 13.

Additionally, the Jupiter Moon Callisto is to be a radar target, but the first scheduled attempt was unsuccessful due to inability to get the DSS 14 400-kW R&D transmitter and the DSS 13 SDS 930 computer working.

B. In Support of Section 332

1. *Tricone support structure (TCSS).* The TCSS destined for DSS 63, which has already been completely tested, was dismantled and shipped to Philco-Ford for packaging for overseas shipment. Philco-Ford has completed this packaging, and the TCSS is on its way to DSS 63.

2. *26-m antenna azimuth drive maintenance.* Another of the azimuth drive gearboxes (see Ref. 2) showed signs of incipient failure and was replaced by a previously rebuilt unit. Although still operating on only two gearboxes and hydraulic motors, the two units now in service on the 26-m antenna have been rebuilt, and the other two units are being rebuilt by the manufacturer, Falk Gear Corp.

The oil seal on one of the two elevation drive screws began leaking and required replacement. This opportunity was also utilized to rebuild the oil pumps (within the ball nuts) to assure good lubrication.

C. In Support of Section 333

1. *Precision antenna gain measurement.* Using the Apollo Lunar Surface Experiments Package (ALSEP) and the radio stars Cassiopeia A, Cygnus A, and Virgo A as calibration sources, support of this program continued. Section 333 personnel, assisted by station personnel, collected data with which absolute antenna gain and absolute flux density can be determined. During this period, 102 hours were devoted to ALSEP and 100.5 hours to the radio stars.

2. *Weak source observations.* Using almost completely automated data-taking techniques, measurements continue to be made on a number of radio stars. Thus far in 1972, data have been taken on 25 radio stars, with a wide range of declinations. From this set of 25 stars, it is hoped that a suitable set of calibration sources can be selected for use with both the 26- and 64-m subnets. This set of calibrators will have their absolute flux density determined at DSS 13 and the measurements then transferred to the rest of the network.

3. *Automatic antenna tracking.* In conjunction with a lecture covering the theoretical basis for the technique, the automatic antenna tracking capabilities of the Scan and Correct Using Receiver (SCOUR) computer program were demonstrated using ALSEP 12 and several radio stars as sources. This program, utilizing an SDS 930 computer, gives the 26-m antenna (which is not equipped with a monopulse cone or a tracking receiver) the ability

to automatically correct its "pointing" as a function of received signal strength. With minor modifications this program can be implemented at DSS 14 and provide similar capabilities for the 64-m antenna which also is not equipped with a monopulse feed or tracking receiver.

D. In Support of Section 335

1. *Dual-carrier measurements.* In further support of the Viking Project, measurements were made at DSS 13 to ascertain the best choice of channel frequencies to minimize intermodulation product interference when operating in the dual-carrier mode. Although channel frequency recommendations have been made, a thorough investigation into sources of, and techniques for eliminating, noise bursts and intermodulation products is underway. It is anticipated that the bulk of this program will be carried out at the Venus station after equipping the 26-m antenna with a diplexer, harmonic filter, and bandpass filter to simulate a 64-m antenna with a 400-kW transmitter.

E. In Support of Section 337

1. *Clock synchronization transmissions.* Routine transmissions, as scheduled by DSN scheduling, continue to those stations which have operational receivers. During this period, transmissions were made as tabulated in Table 1.

2. *DSN 400-kW transmitter support (DSS 14).* Due to the importance of the DSN 400-kW transmitter at DSS 14 to the Mariner 9 Project, an intense effort is being made to keep it operational for each committed track. This effort also includes a comprehensive training program for DSS 14 and Technical Staff personnel at Goldstone. DSS 13 aided this program by providing personnel to work shift with the DSS 14 personnel during the Mariner 9 passes for which the transmitter was committed. In addition, certain sections of the training course were taught by DSS 13 personnel while other instruction utilized DSS 13 equipment as schedule conflicts prevented the DSS 14 transmitter from being made available for training activities as much as would have been desirable.

II. Microwave Test Facility (MTF) Activities

A. In Support of Section 333

1. *Antenna panel noise burst generation.* The noise burst testing, using the antenna sections irradiated by the 20-kW transmitter, has temporarily ceased at MTF. The generation of noise by the antenna panels was discovered to be more complex than the simple mechanism of small arcs taking place between the untaped joints on the an-

tenna surface. Deeper portions of the antenna surface, when exposed to RF, also generate noise. The information collected during these experiments, coupled with the discovery that the taping on the subreflector at DSS 14 has numerous cracks in it, has contributed to a decision to launch an extensive investigation of the problem, probably at DSS 13.

B. In Support of Section 335

1. Pocket RF monitor. In view of the high power densities which are and will be present upon DSN antennas, coupled with the necessity for continuing normal operations in a safe manner, a reliable automatic RF field intensity alarm is desirable. Such a device, worn by personnel

likely to be exposed to possibly hazardous fields, would generate an aural alarm if the impinging radiation exceeded the set point, usually 1 milliwatt per square centimeter. A battery-operated low power drain breadboard model has been completed and after life testing will be repackaged into a pocket size unit for "wearability" tests.

C. In Support of Section 337

1. Klystron testing. In continuing support of the DSN transmitters, five model 4KM50SI klystrons were tested and operational parameter values measured. Data sheets were enclosed with the tubes so that DSN stations placing these tubes into service will have proven baseline values with which to work.

References

1. Jackson, E. B., "DSN Research and Technology Support," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. VIII, pp. 68-73. Jet Propulsion Laboratory, Pasadena, Calif., Apr. 15, 1972.
2. Jackson, E. B., and Kolbly, R. B., "DSN Research and Technology Support," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. IX, pp. 147-151. Jet Propulsion Laboratory, Pasadena, Calif., June 15, 1972.

Table 1. Clock synchronization activity from DSS 13

Station	Number of transmissions
DSS 14	21
DSS 41	35
DSS 42	28
DSS 51	14
DSS 62	30
USNO	22